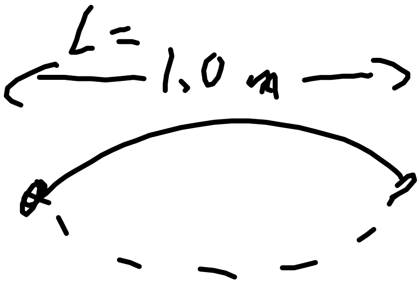
eg. The speed of a wave in a steel string is 2000 m/s with a length 1.0 m. What are the lowest frequency that resonates in the string? What are the 2 overtones (next 2 freqencies).



$v = 2000 m/s$

$f = ?$

$L = \frac{\lambda}{2} = \frac{v}{2f}$ $f = \frac{v}{2L}$

$$f = \frac{2000 m/s}{2(1.0m)} = 10 KHz$$

next two overtones will be 2 and 3 kHz

eg. You hit a 392 Hz tuning fork and hold it over a closed tube that resonates (you hear an echo) when it is 21 cm long. What is the speed of sound in air in this room? (ignore the end correction - the anti-node is actually a little outside the tube)

f=392Hz L=21cm L=(2N-1)λ/4

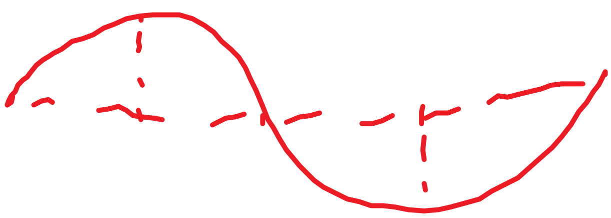
λ=v/f   v=λf = 4Lf = 4x0.21x392=329.28

3.3×10^2 m/s

accepted value is 343ish   Why the slight difference? Could be measurement uncertainty +/- 1cm but there is the end correction, the anti-node is actually a little bit out of the tube, x.

$L_1 + x = \frac{\lambda}{4}$

$L_2 + x = \frac{3\lambda}{4}$



resonant spacing

$= L_2 - L_1$

$= \left[\frac{3\lambda}{4} - x\right] - \left[\frac{\lambda}{4} - x\right]$

$L_2 - L_1 = \frac{\lambda}{2}$ no x

Lab measure v using resonant spacing $L_2 - L_1 = \frac{\lambda}{2}$

$v = \lambda f$

p312 CR 1.1-1.4
p324 CR 2.1-2.4

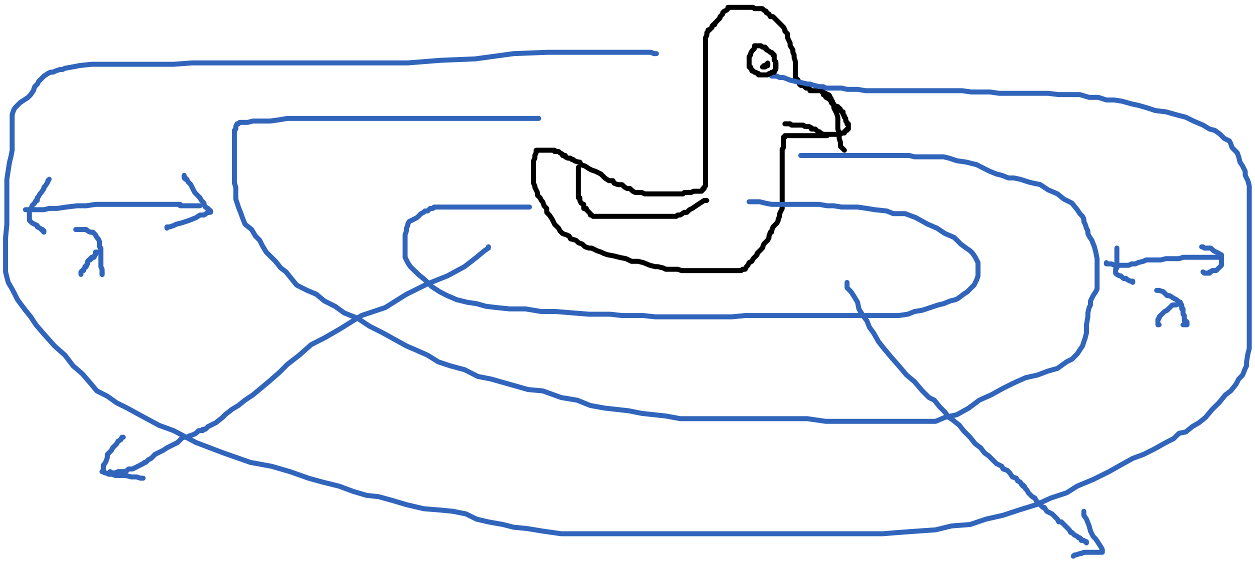
Throwing ball with buzzer inside. (thanks Mr. Schaub)

When the ball moves towards you, you hear a higher pitch, (higher frequency) when it moves away, you hear a lower pitch (lower frequency)

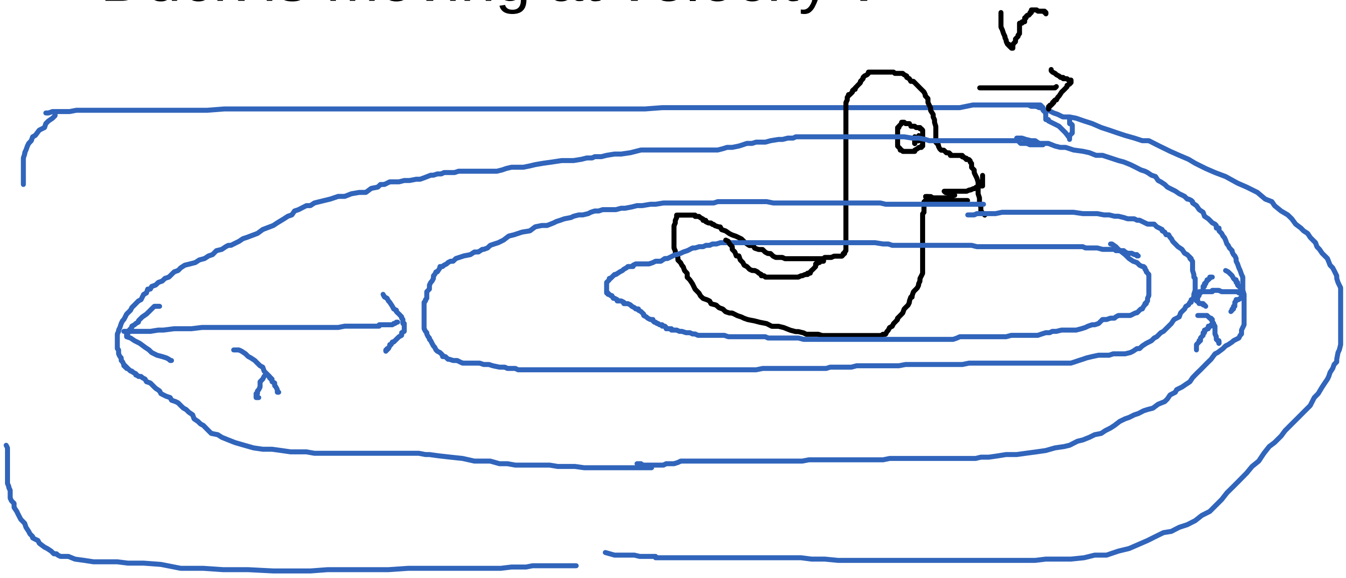
What's the deal?

Look at a duck on water. It produces water waves moving out in concentric circles.

Duck is not moving:



Duck is moving at velocity v



waves are bunched up in front, spread out behind.
higher frequency in front and a lower frequency behind the duck
hence: neeeeeeyoooooowww sound

keen, derive the equation for the frequency given that the wavelength changes by a distance u_s x t, where u_s is the speed of the duck and v is the speed of the wave.